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Eulalia gemina (Phyllodocidae: Polychaeta), a new species from Shirahama, Japan

Tetsuya Kato, Fredrik Pleijel, and Shunsuke F. Mawatari

(TK, SFM) Division of Biological Sciences, Graduate School of Science, Hokkaido University, Sapporo 060-0810, Japan;
(FP) Muséum National d'Histoire Naturelle, Laboratoire de Biologie des Invertébrés Marins et Malacologie, ESA CNRS 8044, 57 rue Cuvier, 75231 Paris Cedex 05, France

Abstract.—*Eulalia gemina,* a new phyllodocid species, is described from intertidal rocks at Shirahama, Honshu, Japan. It is characterized by a specific pigmentation pattern and by a unique combination of characters. The new species is compared to a series of other *Eulalia* Savigny *in* Lamarck, 1822, which it approaches in pigmentation patterns, body shape, and/or shape of the dorsal cirri. *Eulalia ornata* Saint-Joseph, 1888 and *E. myriacycla* (Schmarda, 1861) are considered most similar. *Eulalia pacifica* (Imajima, 1964), new combination, is transferred from *Steggoa* Bergström, 1914.

In terms of species richness, *Eulalia* Savigny *in* Lamarck, 1822 is one of the largest genera of phyllodocids, including ca. 80 nominal species (Pleijel 1991). In Japanese waters four species have previously been recorded (Uchida 1988), five with the inclusion of *Steggoa pacifica* Imajima, 1964 (see below). Here we describe a new species of *Eulalia* from the Pacific side of southern Japan, occurring intertidally in deep crevices in pudding stone. In spite of being distinctive both by its large size (over 15 cm in length) and in its striking pigmentation (yellow green with two transverse, dorsal green bands on each segment), the new taxon has previously been overlooked, presumably due to the poorly studied habitat where it occurs.

Materials and Methods

Specimens were collected intertidally from crevices in pudding stone (conglomerate: clastic sedimentary rock composed by rounded stones in a cement of calcareous material), relaxed in 10% magnesium chloride, fixed in calcium carbonate-buffered formalin in sea water (10%) for at least 24 hrs, rinsed in fresh water, and transferred to 70% ethanol. Drawings were prepared from preserved specimens with a camera lucida.

Museums are indicated by the following abbreviations: Zoological Institute, Faculty of Science, Hokkaido University, Sapporo, Japan (ZIHU); Muséum National d'Histoire Naturelle, Paris, France (MNHN).

Eulalia gemina, new species
Figs. 1–3

Material examined.—Holotype (ZIHU 1333), 10 paratypes (ZIHU 1334–1343), 6 paratypes (MNHN-POLY64, Shirahama, Wakayama, Honshu, Japan, 33°41′N, 135°20′E, intertidal rocky shore, 13 May 1998; 3 paratypes (ZIHU 1344–1346), same locality, 19–20 Apr 1995.

Description.—Holotype complete ovigerous female, 138 mm long and 1.0 mm wide at middle of body (including parapodia but excluding chaetae), for 457 segments. Largest paratype specimen 176 mm long and 1.2 mm wide at middle of body, for 530 segments (lacking posterior end; see Fig. 3 for other paratypes).

Body long and slender, ventrally flat-

tened, of almost uniform width. Prostomium rounded rectangular, slightly wider than long, with delineated protuberance at base of paired antennae (Fig. 1A). Eyes rounded, ca. 1/5 to 1/6 as wide as prostomium, situated near posterior margin of prostomium. Paired antennae cylindrical, slightly shorter than prostomium (Fig. 1A–C). Median antenna similar to paired ones in length, slightly narrower, situated anterior to eyes medially on prostomium (Fig. 1A). Nuchal organs not observed.

Entire surface of proboscis covered with diffusely distributed, rounded papillae (examined by dissection). Terminal proboscis ring with 13–18 papillae.

Dorsal tentacular cirri cylindrical, ventral ones slightly flattened (Figs. 1B, C, 2A–C). Segment 1 dorsally and ventrally fully developed. Tentacular cirri of segment 1 reaching segment 4–5; dorsal and ventral tentacular cirri of segment 2 reaching segments 8–9 and 5, respectively; dorsal tentacular cirri of segment 3 reaching segment 8–10. Segment 2 lacking neuropodial lobes and chaetae (Fig. 2B). Segment 3 with neuropodial lobes and ca. 7 chaetae (Fig. 2C). Ventral cirri of segment 3 similar in shape to but slightly smaller than those of following segments, which gradually increase in size.

Dorsal cirri of anterior and median segments lanceolate, ca. twice as long as broad, with pointed tips (Fig. 2D–G); dorsal cirri of posterior segments shorter, more conical and inflated (Fig. 2H, I). Neuropodial lobes short, rounded, supra-and subacicular lips of equal size, with ca. 10 chaetae. Rostrum of chaetal shaft symmetrical, with large number of teeth, decreasing in size proximally. Chaetal blades short. Ventral cirri of anterior and median segments oval, longer than neuropodial lobes (Fig. 2E, G); ventral cirri of posterior segments rounded triangular (Fig. 2I).

Pygidial cirri cylindrical, tapered, 3 to 4 times as long as broad (Fig. 1E). Pygidial papilla absent.

Color.—Live specimens with yellow green body and two transverse green bands dorsally on each median segment; anterior segmental bands narrower than posterior ones (Fig. 1A, D). Segment 1 without transverse bands; anterior bands absent from anterior- and posteriormost segments. Prostomium with green pigmentation between and lateral to eyes. Dorsal tentacular cirri of segments 2 and 3 and dorsal side of dorsal cirri with green pigmentation. Eyes dark brown. Ovigerous females with green eggs. Preserved specimens brown with dark brown bands; eyes blackish. Pigmentation pattern well preserved in ethanol.

Habitat.—Intertidally in deep crevices in pudding stone.

Distribution.—Known only from Shirahama, southern Japan.

Reproduction.—Several mature males and females collected in April and May; egg size 60–70 μm in diameter (possibly not yet of full size).

Remarks.—The present species is assigned to *Eulalia* based on the following combination of characters: five antennae, prostomium with delineated protuberance, proboscis with diffusely distributed rounded papillae, four pairs of tentacular cirri (1+2+1), all anterior segments developed and separate, chaetae present from segment 3, chaetigerous lobes symmetrical, and rostrum of chaetal shafts with large number of teeth which decrease in size proximally. These characters agree with the diagnosis of *Eulalia* given by Pleijel (1991) and largely (with due adjustment for *Steggoa* as a junior synonym of *Eulalia*; see Pleijel 1987) with those given by Bergström (1914) and Uschakov (1972).

Distinctive pigmentation patterns occur in many members of *Eulalia,* such as *E. bilineata* (Johnston, 1840), *E. tripunctata* McIntosh, 1874, *E. aurea* Gravier, 1896, and *E. ornata* Saint-Joseph, 1888. Among these, *E. gemina* most closely resembles the European *E. ornata,* which has two transverse segmental bands similar to those of *E. gemina.* The two taxa, however, differ in a number of details in the pigmentation: the anterior trans-

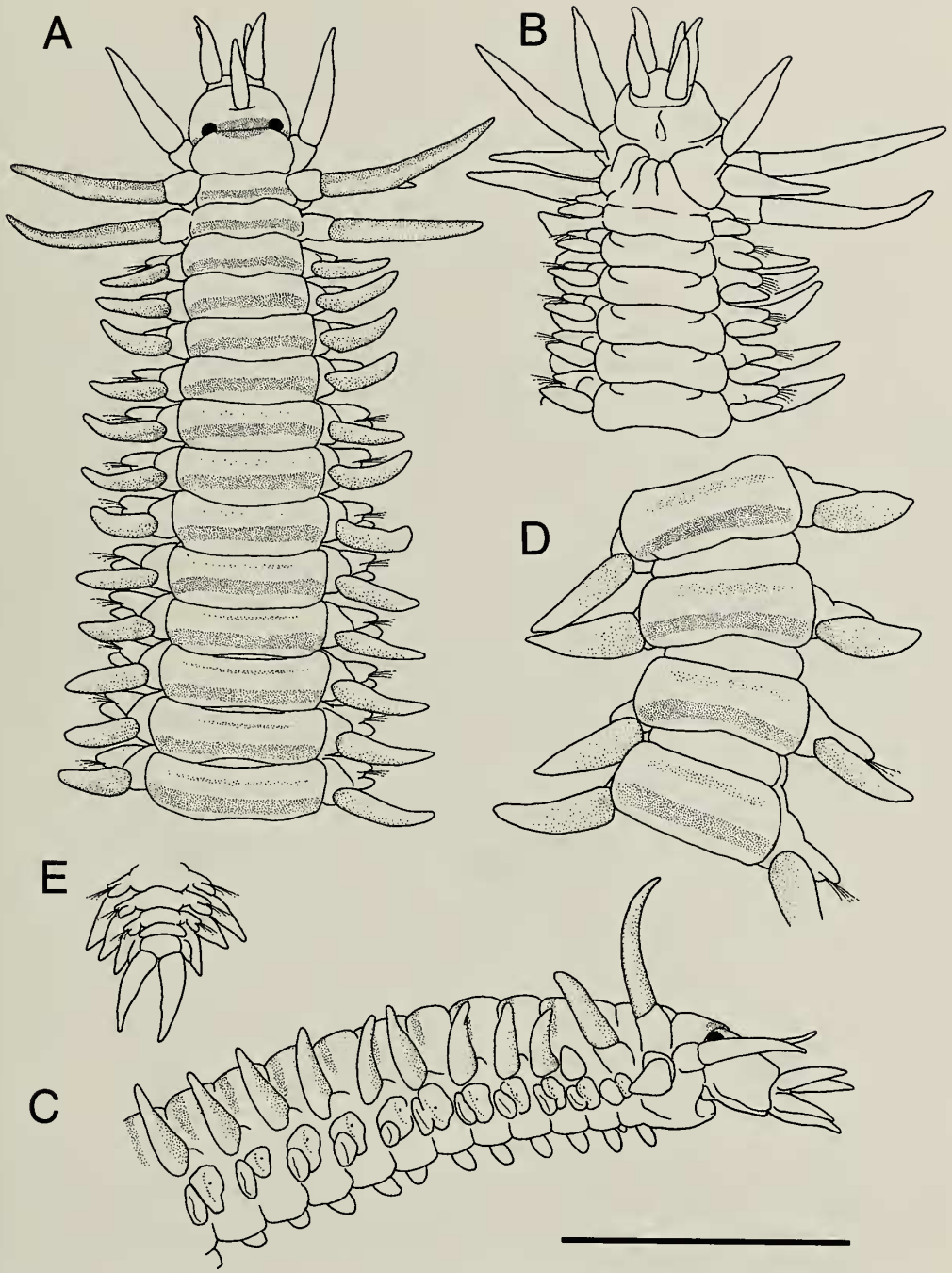

Fig. 1. *Eulalia gemina,* new species. Holotype. A, anterior end, dorsal view; B, anterior end, ventral view; C, anterior end, lateral view; D, median segments, dorsal view; E, posterior end, ventral view. Scale line: 1 mm.

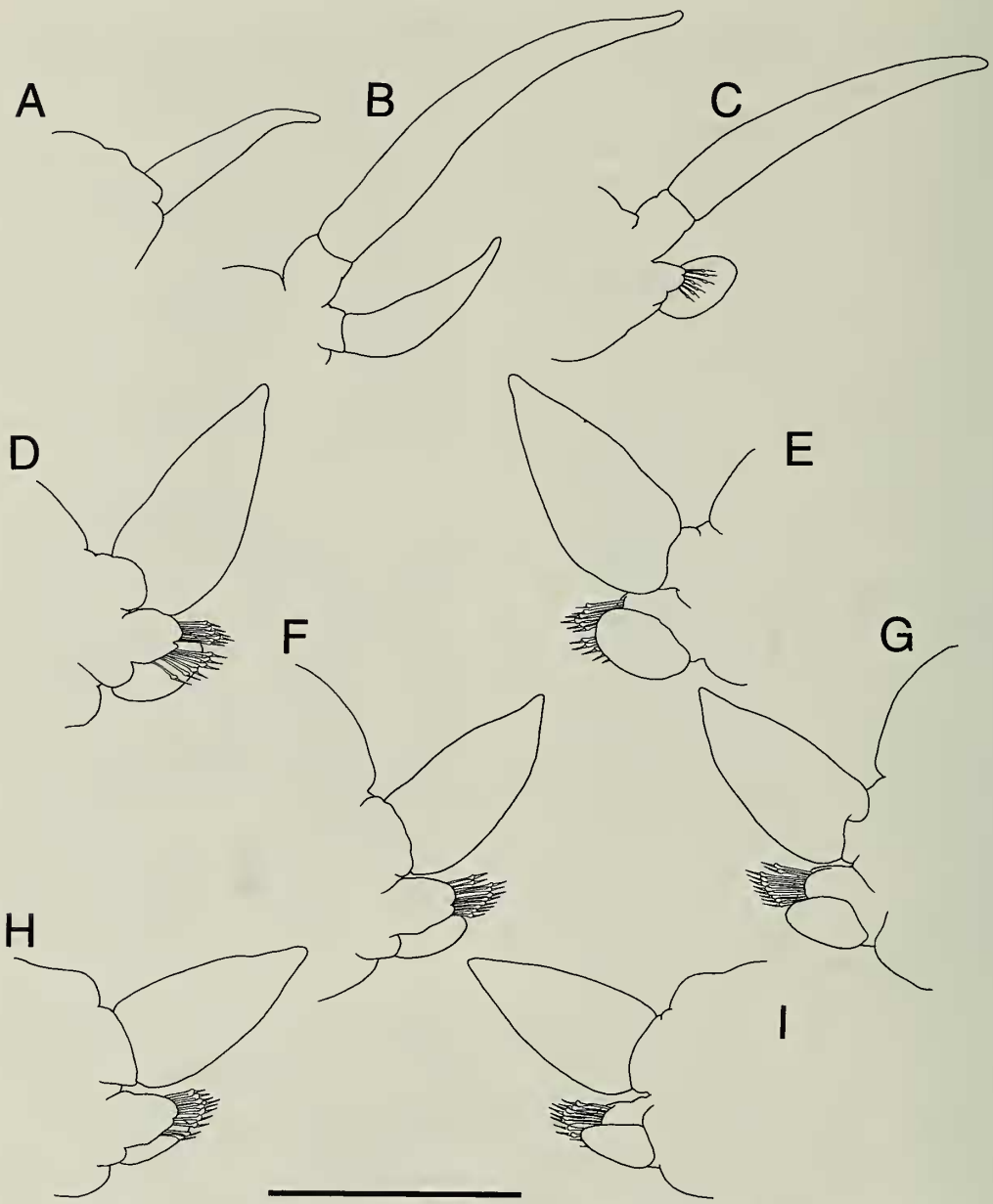

Fig. 2. *Eulalia gemina,* new species. Paratype. A, segment 1, anterior view; B, segment 2, anterior view; C, segment 3, anterior view; D, parapodium segment 23, anterior view; E, parapodium segment 23, posterior view; F, parapodium segment 206, anterior view; G, parapodium segment 206, posterior view; H, parapodium segment 402, anterior view; I, parapodium segment 402, posterior view. Scale line: 500 μm.

verse segmental bands in *E. gemina* are narrower than the posterior ones and absent from anterior and posterior segments, while in *E. ornata* these bands are similar and present on all segments; there is a pair of dark spots medially on each segment in *E. ornata,* but these are absent in *E. gemina*; there are green spots between and laterally to the eyes in *E. gemina,* whereas in *E. ornata* there is only faint yellow pigmentation laterally on the prosto-

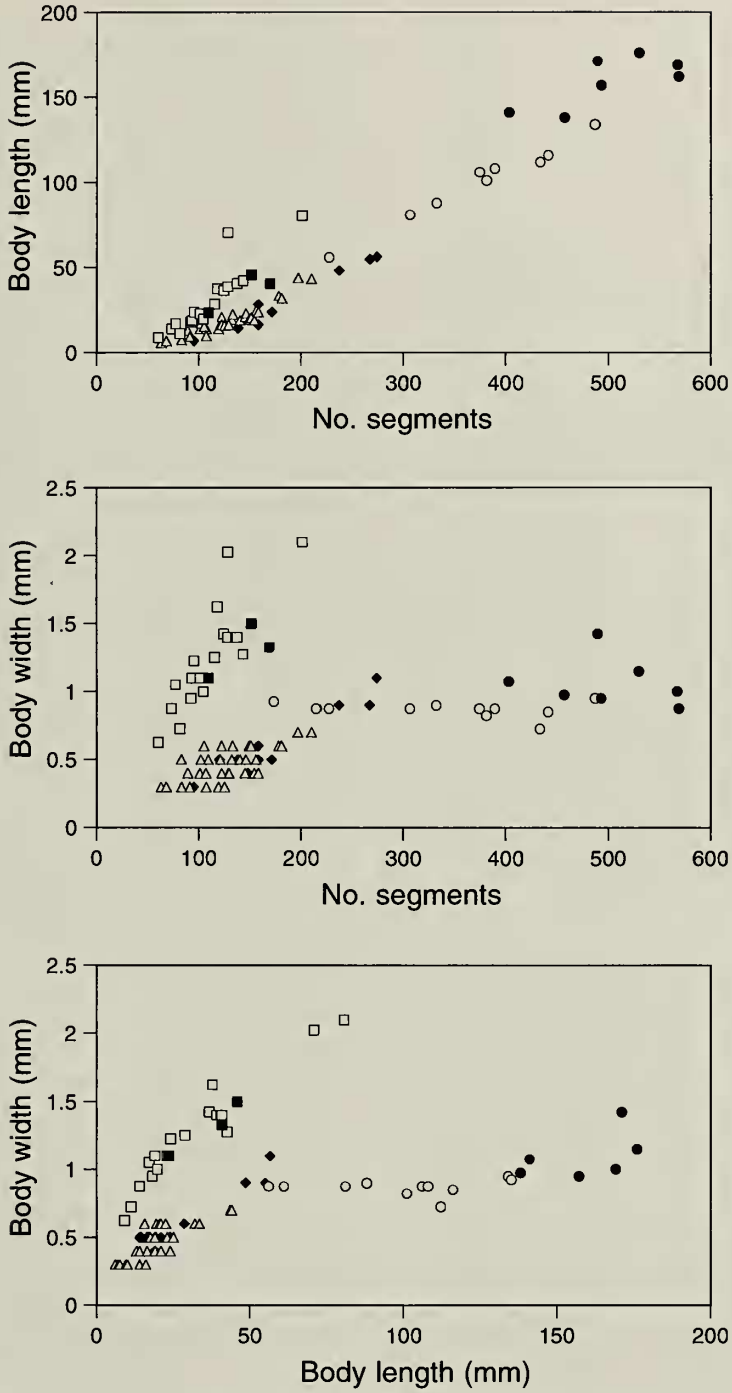

Fig. 3. Relationship between body length, body width and number of segments in *Eulalia gemina, E. ornata, E. bilineata* and *E. tripunctata.* Closed circles represent mature and open circles immature specimens of *E. gemina,* closed squares represent mature females and open squares males and immature specimens of *E. ornata* from Brittany, France, triangles represent *E. bilineata* from the Faeroes and Iceland, and diamonds *E. tripunctata* from England and Italy.

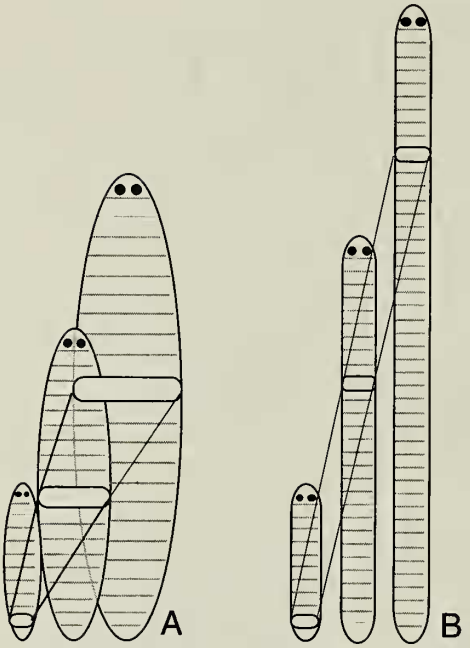

Fig. 4. Models of two growth patterns in *Eulalia.* As in other annelids, new segments are formed from the prepygidial region. A illustrates species with fusiform body shapes such as *E. viridis* and *E. ornata,* where median segments continue to increase in size during the ontogeny. B illustrates uniformly slender species such as *E. gemina* and *E. bilineata,* where newly generated segments reach their final size soon after formation.

mium; the transverse dorsal bands in *E. gemina* are narrower on anterior segments than further back, but in *E. ornata* it is the anterior bands what are widest. *Eulalia gemina* is also similar to *E. quadrilineata* Saint-Joseph, 1898 from Brittany, France, both in pigmentation and in the shape of the dorsal cirri. Unfortunately, in the absence of a detailed description and of types as well as other specimens, *E. quadrilineata* must be considered a nom. dub. (Pleijel 1991). With reference to Saint-Joseph's original description, it differs from *E. gemina* in having dorsal longitudinal violet bands, and in having neuropodia and chaetae on segment 2.

If body shape is considered, two groups can be identified within *Eulalia* (with intermediates), where *E. viridis* (Linnaeus, 1767) may exemplify taxa where median segments apparently continue to increase in size throughout the life time of the animal. This growth pattern yields body shapes with tapering anterior and posterior ends, here labeled fusiform. The second group is exemplified by *E. bilineata* or *E. myriacycla* (Schmarda, 1861), where all segments appear to reach their final size soon after formation, with little subsequent growth. This growth pattern instead yields long and slender body shapes of almost uniform widths. The two patterns are illustrated in Fig. 4. *Eulalia gemina* obviously belongs to this second group (Fig. 3). It also obtains a larger number of segments than any other measured *Eulalia* with the exception only of *E. myriacycla.* This latter taxon differs from *E. gemina* in having 5 dark dorsal longitudinal bands and in having pointed ventral cirri and elongated, slightly flattened pygidial cirri (Eibye-Jacobsen 1992).

If shape of dorsal cirri is considered, two groups can again be identified within *Eulalia.* Taxa such as *E. bilineata* and *E. mustela* Pleijel, 1987 have rounded dorsal cirri which are symmetrical along the longitudinal axis. *Eulalia viridis, E. ornata* and *E. myriacycla,* among others, have dorsal cirri which instead are pointed and asymmetrical along the longitudinal axis as seen in anterior or posterior view. The shape of the dorsal cirri in *Eulalia gemina* is similar to this second group.

In summary, in pigmentation *E. gemina* resembles *E. ornata,* in body shape it is similar to a group including *E. bilineata* and *E. myriacycla,* and in the shape of the dorsal cirri it resembles a group including *E. viridis, E. ornata* and *E. myriacycla.* Apart from details in pigmentation, *E. gemina* is not characterized by any single unique feature but has a specific combination of characters which separates it from all other known members of the genus. A summary of characters and character distributions among relevant species of *Eulalia* is provided in Table 1. Possibly, *E. gemina* may be closely related to *E. ornata* and/or *E. myriacycla,* but a closer investigation of its position would require a full revision of *Eulalia.*

Table 1.—Characters and character distributions among relevant species.

Species	Sources of information	Body shape	First chaetiger	Shape, symmetry, dorsal cirri	Shape ventral cirri	Shape pygidial cirri	Pigmentation pattern	Transverse segmental bands	Paired dark brown middorsal segmental spots	Paired longitudinal violet bands
Eulalia gemina, new species	holotype, 19 paratypes from Shirahama, Japan	slender	segment 3	lanceolate, asymmetrical	rounded	tapered with pointed ends	2 transverse dorsal segmental bands	dark green, anterior bands narrower than posterior bands	absent	absent
E. aurea	Pleijel 1993, ca. 30 spms from North Atlantic	stout	segment 3	lanceolate, symmetrical	rounded	tapered with pointed ends	4 longitudinal bands; 2 red and 2 dark	absent	absent	absent
E. bilineata	Pleijel 1993, ca. 40 spms from North Atlantic, ca. 30 spms from Japan	slender	segment 2	oval, symmetrical	rounded	cylindrical with rounded ends	2 longitudinal dark bands	absent	absent	absent
E. myriacycla	Eibye-Jacobsen 1992, 2 spms from California	slender	segment 3 or 4	lanceolate, asymmetrical	pointed	elongated oval with rounded ends	5 longitudinal bands	absent	absent	absent
E. ornata	Pleijel 1993, 47 spms from Brittany, France	stout	segment 3	lanceolate, asymmetrical	rounded	tapered with pointed ends	2 transverse dorsal segmental bands	dark green, of equal size	present	absent
E. quadrilineata	Saint-Joseph 1898	unknown	segment 2	lanceolate, symmetry unknown	rounded	flattened, probably with rounded ends	2 transverse dorsal segmental bands	color unknown, probably of equal size	absent	present
E. tripunctata	Pleijel 1993, ca. 10 spms from North Atlantic and Mediterranean	slender	segment 2	oval, asymmetrical	rounded	cylindrical with rounded ends	3 black spots on each segment	absent	absent	absent
E. viridis	Pleijel 1993, ca. 180 spms from Japan	stout	segment 2 or 3	lanceolate, asymmetrical	rounded	tapered with pointed ends	uniformly green	absent	absent	absent

Five species of *Eulalia* have hitherto been recorded from Japanese waters: *E. bilineata, E. microphylloides* Hartmann-Schröder, 1979, *E. tenax* (Grube, 1878), *E. viridis* and *E. pacifica* (Imajima, 1964), new combination (Okuda 1940, Imajima 1964, Imajima & Hartman 1964, Uchida 1988). *Eulalia pacifica* was originally referred to *Steggoa,* a generic name which Pleijel (1987) considered a junior synonym of *Eulalia.* Judging from its original description this species also belongs to *Eulalia.* The issue as to whether *E. bilineata* and *E. viridis,* both described from European waters, actually are conspecific with those recorded from Japan is beyond the scope of this study. *Eulalia gemina* is, nevertheless, easily distinguished from both of these in having a slender body and lanceolate dorsal cirri; *E. bilineata* has a slender body but rounded dorsal cirri, and *E. viridis* has pointed lanceolate dorsal cirri but a fusiform body shape. *Eulalia microphylloides* and *E. tenax,* as *E. viridis,* are similar in having lanceolate dorsal cirri, but differ in having fusiform body shapes (Grube 1878, Hartmann-Schröder 1979, Pleijel 1993). *Eulalia pacifica,* a deep water species, is distinguished from *E. gemina* in lacking eyes, and in having a fusiform body shape, asymmetrical ventral tentacular cirri, and oval dorsal cirri. In addition to these differences, the pigmentation pattern of *E. gemina* is unique among all reported Japanese species of *Eulalia.*

Etymology.—The new species is named for the paired dorsal transverse bands on each segment, "*gemina*" being Latin for double, twofold.

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